On the color description of flowers.

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In no respect is the description of a plant more often doubtful than in the color assigned to the flowers, especially if any trace of violet be present in the coloring. It is not at all uncommon to hear some one, reading the description of a flower, exclaim regarding the color, "that is wrong." During the past ten years I have noted with much interest the different expressions used by students in my classes to describe the color of some of our most common wild flowers. As a rule, I have found that young ladies are much more explicit in their description of the color of a flower than the young men of equal intellectual advancement. This is probably not due to a keener color sense, but to the possession of a fuller vocabulary of color terms. In consequence of this fuller vocabulary, the young lady seeks to express smaller differences of color. I have not found, however, that she is more accurate in her description of the color in question. Indeed, it has often seemed to me that the smaller vocabulary has led to a more careful discrimination and a more correct discernment of the components of the color. What we most need is not a fuller vocabulary but a more accurate use of the vocabulary we now possess. It is no doubt a fact that an occasional source of confusion in the description of floral color is a more or less feeble sense in regard to some one color. But this difficulty can not be of sufficiently frequent occurrence to be a serious source of confusion. The percentage of persons who are either color blind or possess only a feeble sense for some one color is so small that there is certainly likely to arise no very frequent trouble from such a source.

The confusion of color description arises mainly from two clearly discernible sources both of which, it seems to me, we may reasonably hope to be able to remove.

The first of these sources needs hardly more than the mere mention to be recognized by every botanist. I refer to the fact that we have absolutely no recognized standards of color, and no generally accepted plan of color nomenclature. To say nothing of the conflicting theories of color which are still in vogue, each of which has its adherents, nearly every writer

on color, who has made the least attempt to suggest a scheme of colors to be used as a basis of color work, has proposed at least one color which is peculiar to himself, either in name or in quality; and in only a few instances has any exact definition been suggested even for a single color. Where one writer has used the term red to designate a primary color, another has used the term vermillion. The former term, without any limitations, will include a variety of hues; and the latter is by no means as definite as might be supposed, since pigments called vermillion by different manufacturers vary greatly in hue. In the few cases in which a particular color term has been proposed and designated by some such definite limitations as the wave length of its vibrations, it has been only for single colors. No series of colors has been proposed as standards upon which a scheme of nomenclature might be based. The result has been the same as before. No remedy for the confusion that prevails is offered.

The second source of confusion is in part dependent upon the first and yet is a very distinct source of trouble. It is the lack of correct color education and ability to correctly analyze color impressions. It has been maintained that the eye does not analyze color impressions. In a sense this is undoubtedly true; but there is also a sense in which it is true that the eye does analyze color. When we look at any patch of color which is not one of the pure spectrum hues, the eye does not see the two colors which would produce that color impression. What we do see is the result of a very complex mixture of light waves of a great variety of wave lengths impinging upon the retina, and the impression is generally due to a preponderance of waves of a rate lying between those of some two well defined colors. Perhaps this can be made clearer if we take an illustration from musical sounds. Suppose the ear to detect a sound having a pitch somewhere between C and D. Now, although the ear does not hear either C or D in that sound, it may be able to determine that the sound lies somewhere between C and D in pitch, and that it lies nearer C than D. Just this same sort of discrimination we need to have taught with regard to color, and especially with regard to the color of flowers. When once we have agreed upon a series of standards of color, this education will be not only possible but easy. With a reasonable amount of training it will not be found difficult to locate any color between two colors of the solar spectrum.

It was these difficulties to which I have above referred in the use of color terms, and certain anomalies which I encountered in the course of a series of physiological investigations regarding color sense, which led me to give my attention to the selection of a system of color standards taken from the solar spectrum, the only source of authority in color. (See *Science* for June 9th, 1893.)

With these standards to work from, I undertook to determine the color analysis of certain of our common flowers. The following results will, I think, be interesting to botanists. The numbers given indicate per cent. of color required to produce the hue of the flower.

The symbols used in the formula stand for the six spectrum colors, viz., red, orange, yellow, green, blue and violet with white and black (N for *niger* being used to avoid the repetition of B).

Common forsythia, F. viridissima: pure spectrum yellow.
Fringed polygala, P. paucifolia: R 48, V 52.
Wistaria, W. frutescens, wings: R 11, V 89.
" " " , standard: R 9, V 79, W 12.
Flowering quince, Cydonia japonica: R 95, V 2, W 3.
Wild cranesbill, Geranium maculatum: R 28, V 66, W 6.

The variations of color in the early summer foliage is also interesting. The following analyses are for the upper side of fresh and well developed healthy leaves. It is not impossible that a little attention to these variations in the color of foliage on the part of artists would save us the annoyance of some of the abominable green which we so often see in the pictures of artists of good reputation.

White oak: Y 7.5, G 11.5, N 81.
Apple: Y 5, G 13, W 2, N 80.
Copper beech: R 17, V 2, N 81.
Hemlock: Y 2, G 9, N 89.
White pine: Y 2.5, G 11, N 86.5.
White birch: Y 5.5, G 11.5, W 1, N 82.
Hornbeam: Y 5.5, G 12.5, N 82.
Shagbark hickory: Y 4.5, G 9.5, N 86.

These analyses were made in a moderately strong diffused light with Maxwell discs of the standard hues referred to above. The discs were combined upon a color wheel giving sufficiently rapid rotation to blend the colors smoothly and give an even surface of color with which to compare the

flower or leaf as the case might be. The analyses can be easily made by any one and after a little practice with a good degree of accuracy. The objects to be gained by such analyses are twofold, viz., the determination of floral color with something like accuracy and the development of a keener perception of color relations. Discs in these standard hues can be obtained at a moderate price and they can be used on any apparatus for rotating the Maxwell discs.

It has already been intimated that greater confusion prevails with regard to violet than any other color. By some writers purple has been used to designate the most refrangable color of the solar spectrum. This is very unfortunate and has led to a great many errors that are exceedingly difficult of correction at the present time. All of the numerous hues to which the term purple is properly applied are combinations of red and violet, often modified by the presence of some white light and almost always with more or less of black, thus forming what is called a broken purple. In the above analyses we have in the fringed polygala the red and violet in nearly equal proportions. The color of the flowering quince is slightlyviolet red modified by the presence of a small portion of white, On the other hand the color of the wistaria is a reddish violet, in the wings modified by white in the standard. The cranesbill is a still more red violet, i. e., it comes nearer to a purple.

The colors assigned to the flowers whose analysis I have given above in two of the botanical text books most commonly used in our schools are as follows: under the description of Polygala paucifolia Wood says, "flower purple" while Gray says, "flower rose purple." Concerning the wistaria both Wood and Gray say, "flower lilac purple." Wood describes the flower of Cydonia Japonica as "crimson." Gray gives the color of Geranium maculatum as "light purple" while Wood calls the same flower simply "purple."

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